

25 of root for 100 of plant in the dark, and
23 " 100 " light.

The close similarity in the evolution of visible structure in the light and in the dark, the small difference in the total weights of the plants grown in the same time in both series, and the close approximation in the proportional weight of root to plant, all justify the conclusion, that the growth in darkness and in light closely resemble each other, and that it is proper to reason as regards the nature of the action from the first to the second.

Another interesting fact which lends support to the opinion that the process of growth in seedlings developed in the dark is very similar to that occurring in those grown in the light, is the character of the excrement thrown out by the roots. It is well known that many plants so poison the soil that the same plants cannot be made to grow therein until the poisonous excretions from the roots of the first crop have been destroyed by oxidation. In the case of peas this poisoning of the soil takes place in a very marked manner, and I have found that in the pots in which peas have been grown in the dark, the soil is so poisoned by the excrements from the roots that a second crop fails to sprout. Does it not follow, that since in the two series with which I experimented, the excrements from the roots possessed the same poisoning action, the processes in the plants from which these excrements arose must have been similar?

There remains an important argument concerning which nothing has thus far been said. It is to be derived from the consideration of the rate of growth in the light series during various periods of the day of twenty-four hours. If the evolution of structure in a plant in daylight is the result of the action of light, that evolution should occur entirely, or almost entirely during the day. If, on the contrary, it is independent of the light, it should go on at a uniform rate as in plants in the dark.

For the elucidation of this portion of the subject, I present the following tables; the first of which shows the growth by night, 7 P.M. to 7 A.M., of the seedlings in the dark series, compared with their growth by day, 7 A.M. to 7 P.M. The measurements were taken from the sixth to the twentieth of the month, the day on which growth ceased in the dark series:—

Table III.—Seedlings grown in the dark

No.	Night growth.	Day growth.
1	12 $\frac{3}{4}$ inches.	14 inches.
2	13 $\frac{1}{2}$ "	13 "
3	11 $\frac{1}{2}$ "	11 $\frac{3}{4}$ "
4	12 $\frac{5}{8}$ "	11 $\frac{1}{2}$ "

Average, 15 $\frac{5}{8}$ " Average, 12 $\frac{3}{4}$ "

The total day growth and night growth under these circumstances are nearly equal, though there is a slight excess in favour of the night, amounting, as the table shows, to $\frac{1}{4}$ of an inch in 12 inches.

In Table IV. the growth of the light series is given in the same manner, by day and by night, for the same time, viz., to June 20. The thermometric and hygrometric conditions in both series were very similar, as indicated by the dry and wet bulb thermometers suspended in the vicinity of each set of tubes:—

Table IV.—Seedlings grown in the light

No.	Night growth.	Day growth.
5	3 $\frac{1}{4}$ inches	4 inches.
6	8 "	7 "
7	5 $\frac{1}{4}$ "	4 $\frac{1}{2}$ "
8	9 $\frac{1}{2}$ "	8 $\frac{1}{2}$ "

Average, 6 $\frac{1}{2}$ " Average, 6 "

In the average, and throughout the table, with a single exception, not only is the uniformity in the rate of growth during the day and night shown, but the slight excess of night growth found in the series kept in the dark is likewise copied. We must therefore accept the conclusion that the act of growth or evolution of structure is independent of light, and that the manner of growth during the day is similar to that at night.

It will be noticed that the total average height attained in the light is only about half that in the dark series. The explanation of this we have already seen in the fact that in the former the leaves and tendrils were much larger than in the latter, while the dry weights were nearly the same. The material of the seed in

the light series was consumed in extending these surfaces, while in the dark series it was spent in lengthening the stem.

Having established the continuous character of growth in seedlings, and the similarity of rate and nature of the process by night and by day, and admitting that at night plants throw off carbonic acid, it is not improbable that this carbonic acid arises, not from mechanical absorption by the roots, and vaporisation by the leaves, but as a direct result or concomitant of the act or process of evolution of structure.

To put the matter in the clearest form, let us first understand what growth is. It appears in all cases to consist in the evolution or production of cells from those already existing. According as the circumstances under which the cells are produced vary, so does the tissue ultimately produced vary. Cells formed in woody fibre become wood. Cells formed in muscle in their turn form muscles, but the starting point of the process in every instance is the formation of new cells.

If now we examine the evolution of cells under the simplest conditions, as, for example, in the fermentation that attends the manufacture of alcohol, we find that with the evolution of the torula cells carbonic acid is produced. The two results are intimately connected, and it is proper to suppose that since the carbonic acid has arisen along with the new cells, the latter operation must in some way involve a process of oxidation. Accepting the hypothesis that oxidation is attendant on these processes of cell growth under the simplest conditions, we pass to the examination of what occurs in the lowest forms of vegetable organisms found in the air.

The fungi, and indeed all plants that are not green, with a few exceptions, exhale carbonic acid and never exhale oxygen. In this case, in which cell production often occurs with such marvellous rapidity, the carbonic acid must have arisen as a consequent of the cell growth. It is improbable that it has been absorbed by roots and exhaled from the structures, either in these plants or in those produced during fermentation. In the latter there never are any roots, and in the former, even where roots are present, they bear a small proportion to the whole plant. The quantity of moisture exhaled by such growths is also insignificant, and out of proportion to the carbonic acid evolved. We must, therefore, in this case decline to accept the root-absorption hypothesis, and admit that the carbonic acid has arisen as a result of the cell growth in the plant.

Passing to the chlorophyll-bearing plants, we find that in the Phanerogamia it is only the green parts that at any time exhale oxygen, and then only under the influence of sunshine. The other parts of the plant above the ground, that are not green, viz., the stem, twigs, flowers, &c., are at all times, day and night, exhaling carbonic acid. The whole history of the plant, from the time the seed is planted, to its death, is a continuous story of oxidation, except when sunlight is falling on the leaves. The seed is put into the ground, and during germination oxygen is absorbed and carbonic acid exhaled. If the seedling be kept in the dark, oxygen is never exhaled, carbonic acid is, and the plant not only grows, but all visible structures except flowers are formed in a rudimentary condition. In the light the growth during the night time is attended by the evolution of carbonic acid, while during the day time the bark of the stem and branches is throwing off carbonic acid. When flowers and seeds form, the evolution of carbonic acid attending this highest act of which the plant is capable, is often greater than that produced at any time in many animals.

Everything in the history of plants, therefore, tends to show that the evolution of their structures is inseparably attended by the formation of carbonic acid; and it seems impossible, when we consider the evolution alone, to arrive at any other opinion than that already expressed—that, all living things, whether plant or animal, absorb oxygen and evolve carbonic acid, or some other oxidised substance, as an essential condition of the evolution of their structures.

J. C. DRAPER

SCIENTIFIC SERIALS

THE first number of the *Zeitschrift für Ethnologie* for 1873, opens with an interesting paper by Dr. George Schweinfurth on the Monbutta Tribes of Central Africa, whose name and existence have hitherto been unknown to us. Dr. Ori and M. Jules Poncet had shown that there were important streams south of the Miam-Miam Territory, which took a westerly course, and that the banks of the most considerable of these rivers were

occupied by a brown-skinned race differing widely from the contiguous negro tribes, both in colour and in civilisation. These are the Monbutas, known also to the ivory-traders as the Guruguri, in allusion to their practice of boring their ears. Their country, which Dr. Schweinfurth visited in 1868, and where he remained for five weeks under the special protection of the king, Munsa, is a densely populated district lying between 3 and 4 N. lat., and 28 and 29 E. long., and bounded on the north by the Kibali, a copious stream which unites with the Gadda, and under the name of Uelle receives in its passage through the Miam-Miam country a number of other streams, that serve as feeders to Lake Tsad. The country of the Monbutas, lying at an elevation of from 2,500 to 3,000 ft. above the level of the sea, consists of an ever-varying alternation of gently swelling hills and well-watered valleys, alike rich in palms and bananas, and every other form of luxuriant tropical vegetation. In this earthly paradise where Nature spares man the burden of labour, the people, although living under an organised system of government, and showing extraordinary skill in working metals and in other arts, are habitual cannibals. This is not from want of animal food, as elephants, buffaloes, antelopes and wild swine abound, but whatever the cause may be, the fact is undisputed that the cannibalism of the otherwise gentle Monbutas exceeds that of any other known African nation, and is systematically gratified at the expense of the more degraded blacks living beyond their frontiers, whom they seize and carry away, driving their captives before them like a herd of sheep, and slaughtering them as they need them. The young children and the fattest individuals are kept for the royal kitchen, where the flesh is dried and prepared with capsciums and many savoury fruits for the king, Munsa, whose numerous wives have to take it in turn to cook for him. The power of the king is supreme, and it would appear that the land of the Monbutas may rank as one of the most important monarchical states of Central Africa. In race the people seem to approximate to the Fulbe, and in language to the north equatorial African group. They recognise one supreme being, appear to have no outward symbols of worship, and practise circumcision.—Dr. P. Langerhans has a paper in this number on the anatomical features of interest belonging to a series of facial and cranial measurements, with the corresponding photographs, taken at Jerusalem from among the mixed population of Khurds, Armenians, and Negroes (from Dâr). As a contribution to human comparative anatomy the paper will be found useful.—Those interested in the study of the prehistoric remains of Holland and the Low Countries generally will find much serviceable matter in a paper by Dr. Friedel, who points out the distinctions between the Frisic-Germanic and the Celtic-Batavian remains, and passes in review the collections preserved in the various Dutch museums, of which that of Leyden is the most valuable in an ethnological point of view.

Poggendorff's Annalen der Physik und Chemie, No. 5, 1873.—This number contains several papers on electricity. Dr. Hermann Herwig investigates the influence of free electricity at the surface of electrodes, on electro-dynamic phenomena. His experiments were made with a delicate electro-dynamometer, in which the deflections of the bifilar and multiplier coils were compared, the electro-motive force and resistance being varied.—A paper by M. Edlund treats of the chemical action of the galvanic current and the distribution of free electricity on the surface of an electrode. The author applies his theory (of electricity being a phenomenon of the luminiferous ether), to the decomposition of water by a current, and institutes a comparison between what occurs in a ring-tube in which a gas is forced into circulation from a certain point, with the phenomena in a galvanic circuit. In another note the same author opposes von Bezold's explanation of "disjunction currents," which he thinks are due to an electro-motive force in the voltaic arc itself, not to a difference in tension between the electrodes.—M. Wüllner describes experiments confirming his former assertion (questioned by Schuster) that nitrogen, in Geissler tubes, gives both a band and a line spectrum. A valuable series of experiments on heat consumption in the solution of salts, and the specific heats of salt solutions is detailed by Dr. Winkelmann, who here extends the previous work of Graham and Person on the subject.—There are also papers on the change of volume of solid substances through the formation of chemical combinations of the same aggregate state (W. Müller), on the pole-points of a magnet (Riecke), on the dynamical principle of Hamilton in thermo-dynamics (Szily), on a

new mode of exhibiting metallic spectra (Edelmann), and one or two others.

THE July and August numbers of the *American Naturalist* contain, among others, the following papers:—Dr. Elliott Coues discusses the relationship between the Prairie Wolf, or Coyoté (*Canis latrans*), and the common dog, taking a pointer as his type, which is much of the same size. The physiognomy of the former is said to be between that of a wolf and a fox, "but more doggy than either." Its affinities with the dog are shown to be extremely close.—Mr. T. M. Trippe gives reasons for instances of irregular migrations of birds, showing that some depend on human interference, and changes in climate, and others are as yet unexplained.—Prof. Verrill describes a new species of Octopus (*O. bairdii*) from the bay of Fundy. It is somewhat related to *O. groenlandicus*, but differs in the hectocotylised arm being longer and otherwise different.—Alexander Agassiz, in a fully illustrated article, gives reasons in favour of the supposition that the pedicellariæ and spines of Echinodermata are only modifications of a single type form, to suit different purposes in the animal's economy.—Prof. W. J. Beal, on the phyllotaxy of cones, shows that the well-known laws of phyllotaxis are very general, nevertheless there are exceptions to them, well marked among some cones, as is proved by the author's examination of a very large number from the Norway spruce, in which $\frac{3}{8}$ and $\frac{1}{2}$ were the common fractions.—Mr. A. S. Packard, jun., treats of the distribution of Californian moths, bringing information on their peculiarities to bear on Prof. Gray's work on the distribution of Californian plants.—Dr. Theodore Gill has a paper on the status of Aristotle in systematic zoology, in which he gives very cogent reasons against that great philosopher having the knowledge of the principles of zoology which is ascribed to him by some. He concludes that "there is not the slightest evidence of any recognition of what is now understood by classification in any of the extant treatises of Aristotle on animals, and the systems framed to embody his generalisations have been constructed from isolated sentences wrested from their context, and simply reflect the framer's notions or his ideas as to what Aristotle might have supposed."—Prof. Bessey notes the sensitiveness of the stamens of *Portulaca* and *Claytonia*.

Mittheilungen der Naturforschenden Gesellschaft in Bern, 1872.—Prof. Dor has an article, in this number, on colour blindness. Various experiments are described; the method most preferred having been that of viewing spectral colours with a polarisation prism. The author rejects the Young-Helmholtz theory, which, as is known, supposes three colour-perceiving elements in the retina, those for perception of red, those for green, and those for violet (or blue). Among his objections are these: absence of anatomical proof; distinct vision of many of the colour blind; the spectrum as observed by two persons, brothers, who had no perception of red or violet, was of normal length; all the pathologically colour blind suffered from atrophy of the optic nerve through cerebral or spinal injuries; in these cases, the fibrous and cellular layer of the retina, and the optic nerve, to the brain, were atrophied, but not the rods and cones; in retinal disease, on the other hand, the perception of colours is not perverted, though diminished. He concludes that colour blindness is a cerebral affection.—A note by Dr. Adolph Vogt treats of the drainage of towns, in view of a faulty state of things at Bern.—The action of Buss's new governor is discussed in a paper of some length by the inventor.—Dr. A. Forster communicates a note on the falling stars of November last, also meteorological observations at the Bern Observatory during 1872. From the curve of daily temperature variations at Bern it appears that these are sometimes considerable, e.g. 18° C. in 24 hours, a fact of significance for health.—We may further note, in this number, some contributions to local botany, by Dr. Wydler.

SOCIETIES AND ACADEMIES

BELGIUM

Royal Academy of Sciences, June 7.—M. Quetelet presented a note on the solar eclipse of May 26, 1873.—M. Montigny gave the results of a second series of experiments made on the spire of Antwerp Cathedral, in which he determined barometrically the heights at several points, in winds of different direction and velocity. His tables show a difference between the calculated height and the real height, the latter being greater for winds of the eastern semicircle, while the former is greater